DESCRIPTION

EQUIPMENT FOR CARBON DIOXIDE RECOVERY AND COMBUSTION

Technical Field

The present invention relates to an apparatus for carbon dioxide recovery and combustion which is provided with a combustion unit capable of complete combustion of waste matter or the like at high temperature and a carbon dioxide recovery unit which liquefies and recovers carbon dioxide (CO_2) in the atmosphere or elsewhere.

Background Art

Conventional combustion devices capable of complete combustion of waste matter or the like at high temperature include what pertains to a research work by the applicant of the present application and include, for instance, what is described in Patent Document 1 (Pamphlet of International Publication No. 2005/033582).

In this combustion device, a fluid feed mixed with water is fed to a combustible substance, which is waste matter or the like, and water in the fluid feed is pyrolyzed to burn the substance and the carbon dioxide-containing gas after the combustion is discharged. The gas discharged from the combustion unit is separated by a centrifuge into various gases including hydrogen and carbon dioxide.

Meanwhile, achievements of research by the applicant of the present application include a carbon dioxide recovery unit which takes out carbon dioxide (Japanese Patent Application Laid-Open No. 2005-82419).

This carbon dioxide recovery unit feeds atmospheric air together with liquid nitrogen into a container, liquefies carbon dioxide by having heat exchanged between carbon dioxide and liquid nitrogen in the container and preserves the liquefied carbon dioxide.

Patent Document 1: Pamphlet of International Publication No. 2005/033582

Patent Document 2: Japanese Patent Laid-Open No. 2005-82419

Disclosure of the Invention

However, though carbon dioxide is separated and recovered by a centrifuge from other gases in the above-cited combustion unit, it is not

necessarily certain that carbon dioxide is selectively recovered, resulting in a problem of poor efficiency of carbon dioxide recovery.

On the other hand the above-cited apparatus for carbon dioxide recovery, since it recovers only carbon dioxide in the atmosphere, involves a problem of limited utility.

An object of the present invention, attempted in view of the problems noted above, is to provide an apparatus for carbon dioxide recovery and combustion improved in the efficiency of carbon dioxide recovery by liquefying gases discharged from a combustion unit with a carbon dioxide recovery unit and selectively recovering carbon dioxide.

An apparatus for carbon dioxide recovery and combustion according to the invention intended to achieve this object has a configuration being equipped with a carbon dioxide recovery unit which feeds carbon dioxide or a carbon dioxide-containing gas into a container, feeds liquid nitrogen into the container and causes heat exchange between carbon dioxide and liquid nitrogen in the container to cause liquefaction of carbon dioxide, and a combustion unit into which fluid feed comprising a combustible substance mixed with water is fed, water in the fluid feed is pyrolyzed to burn the combustible substance and a carbon dioxide-containing gas after the combustion is discharged, and at least carbon dioxide in the gas is delivered into the container of the carbon dioxide recovery unit.

This enables carbon dioxide to be liquefied and selectively recovered by exchanging heat between the carbon dioxide of gas discharged from the combustion unit and liquid nitrogen in the container of the carbon dioxide recovery unit. As a result, carbon dioxide can be efficiently recovered.

In another configuration of the apparatus for carbon dioxide recovery and combustion according to the invention, the carbon dioxide recovery unit is provided with a container which permits liquefied carbon dioxide to be taken out from the bottom thereof, a hollow rotor which, disposed to be rotatable relative to the container, sucks gas and centrifugally separates carbon dioxide toward the outer circumference to compressively collect the gas, injects from a plurality of blast nozzles disposed on the outer circumference the separated and compressively collected carbon dioxide together with liquid nitrogen into the container, and causes heat exchange between carbon dioxide and liquid nitrogen in the container to cause liquefaction of carbon dioxide, a rotor driving means which turns the rotor, a gas sucking part which, disposed in the rotor, sucks gas, a gas discharging part which, disposed in the rotor, discharges

unnecessary gases, a liquid nitrogen sprinkling part which, disposed in the rotor, sprinkles liquid nitrogen in the rotor, and a liquid nitrogen feeding part which feeds the liquid nitrogen sprinkling part with liquid nitrogen.

This enables, when liquefied carbon dioxide is to be recovered, the rotor to be turned by the rotor driving means all the time, and liquid nitrogen to be fed to the liquid nitrogen sprinkling part from the liquid nitrogen feeding part, resulting in injection of liquid nitrogen into the rotor from the liquid nitrogen sprinkling part. Gases from the atmosphere are taken into this rotor, and carbon dioxide is delivered from the combustion unit. Centrifugal compression of these gases in the rotor causes carbon dioxide to be separated and compressively collected toward the outer circumference of the rotor. Unnecessary gases in thee rotor is discharged outside the rotor from the gas discharging part.

The carbon dioxide compressively collected toward the outer circumference of the rotor, together with liquid nitrogen injected from the blast nozzles of the liquid nitrogen sprinkling part, is injected into the container from a plurality of injection ports disposed on the outer circumference of the rotor. This injection causes heat exchange between carbon dioxide and liquid nitrogen in the container, and the carbon dioxide is liquefied and flows down to the bottom of the container.

In this case, carbon dioxide is separated and compressively collected toward the outer circumference of the rotor, and the liquefaction of only this compressively collected carbon dioxide enables the minute quantity of carbon dioxide in the air and carbon dioxide from the combustion unit to be selectively and efficiently liquefied.

In another configuration of the apparatus for carbon dioxide recovery and combustion according to the invention, the rotor is formed in a cylindrical shape having the gas sucking part formed at one end in the direction of the rotation axis and the gas discharging part formed at the other end in the direction of the rotation axis, the rotor driving means having a wall part outside the rotor is provided with a cylinder, disposed to be rotatable relative to the container and rotor, having a gas intake part which is disposed toward the other end in the direction of the rotation axis and into which gas flows from the gas discharging part of the rotor and a gas discharge port which is disposed toward one end in the direction of the rotation axis and from which gas inside is discharged toward outside; a moving vane which, disposed at the gas discharge port, receives the gas being discharged from the gas discharge port and turns the cylinder; a

stationary vane which, disposed on a shell covering the container and cylinder, receives the gas being discharged from the gas discharge port; a turning force transmitting mechanism which links the turning force of the cylinder to the turning force of the rotor; a heating fluid scattering part which scatters heating fluid between the rotor and cylinder; and a heating fluid feeding part which feeds the heating fluid scattering part with the heating fluid, wherein a turning force is provided to the rotor and cylinder by cooling gas on one channel which passes the inside of the rotor from the gas sucking part of the rotor and reaches the gas discharging part and heating gas on the other channel which passes the outside of the rotor from the gas discharging part of the rotor and reaches the gas discharge port of the cylinder to cause a flow of gas.

When carbon dioxide is to be recovered by the carbon dioxide recovery unit, the following process takes place.

In the rotor, gas on one channel is cooled by liquid nitrogen from the liquid nitrogen sprinkling part. In this process, the gas on one channel is cooled by the liquid nitrogen and descends. On the other hand, gas that has flowed out of the gas discharging part through the gas intake part into the cylinder exchanges heat with heating fluid from the heating fluid scattering part to be thereby heated and ascend.

Meanwhile, gas ascending on the other channel, when flowing out of the gas discharge port, works on the moving vane to turn the cylinder and blasted toward the stationary vane. The repulsive force deriving from this blasting also works to turn the cylinder.

In this way, the turning force of the cylinder turned by the gas flows on the one channel and the other channel is transmitted to the rotor via the turning force transmitting mechanism. For this reason, unlike in a case in which a motor or the like is used to turn the rotor, carbon dioxide can be recovered with scarce use of motive power from outside, and energy efficiency can be enhanced.

In another configuration, the apparatus for carbon dioxide recovery and combustion according to the invention is further provided with a fulcrum shaft on which the rotor pivots and which is inserted into the rotor, a fixed vane which, disposed on the fulcrum shaft, generates a vortex in gas passing the one channel within the rotor, and a movable vane which, disposed on the inner wall of the rotor, receives the gas made vortical by the fixed vane and turns the rotor.

In the one channel, this causes the fixed vane to make gas on the one channel vortical and the gas thereby made vortical to hit against the movable

vane to further turn the rotor. As a result, since not only the cylinder but also the movable vane can provide a turning force to the rotor, the rotor can be turned more efficiently and faster, enabling the carbon dioxide to be centrifugally compressed in a satisfactory way.

In another configuration of the apparatus for carbon dioxide recovery and combustion according to the invention, the shell is provided with a duct which, in order to make the gas discharged from the gas discharge port available for use, guides the gas out.

This enables the gas to be discharged to be readily guided outward.

In another configuration, the apparatus for carbon dioxide recovery and combustion according to the invention is further provided with a cooling means which cools the gas passing the shell to reach the duct by spraying water.

This enables the trouble of guiding high-temperature gas outward to be prevented.

In another configuration of the apparatus for carbon dioxide recovery and combustion according to the invention, the combustion unit is provided with a combustion chamber which is supplied, in a state of being intercepted from air supply, with a fluid feed comprising a combustible substance mixed with water, burns the combustible substance by pyrolyzing water in the fluid feed and discharges the gas having been subjected to combustion,

a fluid feed supplying part which supplies the fluid feed to the combustion chamber, an outer chamber surrounding the combustion chamber which supports the combustion chamber to permit rotational driving, and a combustion chamber driving means which rotationally drives the combustion chamber, wherein a lower opening which communicates with the inside of the combustion chamber and guides the fluid feed in is disposed in the lower part of the combustion chamber, an upper opening which communicates with the combustion chamber and discharges exhaust is disposed in the upper part of the combustion chamber, the combustion chamber having an outer cylinder and an inner cylinder, and the inner cylinder of the combustion chamber consists of a heat resistant fluid which is pressed onto the outer cylinder by the centrifugal force of the combustion chamber to form the inner wall of the combustion chamber, and the combustion chamber driving means is provided with a power transmitting mechanism which, in linkage with the cylinder, transmits power deriving from the turning force of the cylinder to the combustion chamber.

In the combustion chamber, this results in the supply, in a state of being intercepted from air supply, of a fluid feed comprising a combustible substance mixed with water and burning of the combustible substance by pyrolyzing water in the fluid feed into oxygen and hydrogen and substantially complete combustion of the combustible substance with this oxygen. Further, the centrifugal force deriving from the fast rotation of the combustion chamber causes the heat resistant fluid to form the inner cylinder, and infrared rays are reflected back and forth on the inner face of the cylinder of this dissolved heat resistant fluid to raise the temperature within the combustion chamber to an extremely high level. As a result, an upward vortex is formed within the combustion chamber where the temperature and pressure are raised to high levels, and the oxygen resulting from the pyrolysis of water in the fluid feed causes the combustible substance to be secured of substantially complete combustion.

As air supply into the combustion chamber is intercepted, there is virtually no supply of nitrogen. For this reason, the generation of nitrogen oxides except those attributable to the combustible substance is restrained. As a result, the exhaust gas is made clean, and the carbon dioxide recovery unit can also obtain carbon dioxide of high purity.

As the combustion chamber turns with the turning force of the cylinder as the motive power in this process, and higher energy efficiency can be achieved than in a case in which a motor or the like is provided to turn the combustion chamber.

In another configuration of the apparatus for carbon dioxide recovery and combustion according to the invention, the heating fluid feeding part is provided with a heating fluid circulation duct which recovers heating fluid being scattered in the cylinder and circulates the same in the heating fluid scattering part, and a heating fluid heating part which heats the heating fluid circulating in the heating fluid circulation duct on the route of the heating fluid circulation duct; and the heating fluid heating part is provided with a heat exchanger which causes heat exchange between gas discharged from the combustion unit and the heating fluid.

As this causes the heating fluid to be heated, after the combustible substance has been burnt by the combustion unit, by utilizing the exhaust heat of the gas generated at the time of discharging, energy can be more effectively utilized than in a case in which a separate heating unit for heating the heating fluid is provided.

In another configuration of the apparatus for carbon dioxide recovery and combustion according to the invention, the heat exchanger is provided with a tower, a rotary inner cylinder pivoting on the tower to be rotatable, having a supply inlet for a medium consisting of a gas for heat exchange at one end in the axial direction and a discharge outlet for the medium at the other end, and a rotary outer cylinder which is disposed to be rotatable relative to the tower and rotary inner cylinder, the wall part thereof being positioned between the tower and the rotary inner cylinder, and seals the medium, wherein one channel which reaches the discharge outlet from the supply inlet of the rotary inner cylinder via the inside of the rotary inner cylinder and an other channel which reaches the supply inlet from the discharge outlet of the rotary inner cylinder via the outside of the rotary inner cylinder; a moving vane which receives the medium flowing into the supply inlet and gives a turning force to the rotary inner cylinder is disposed toward one end of the rotary inner cylinder and a guide vane which guides the medium to the moving vane and gives a turning force to the rotary outer cylinder is disposed on the inner circumference toward one end of the rotary outer cylinder; a large number of cooling pipes which cause the heating fluid to flow from one end to the other end in the axial direction to cool the medium passing the one channel are arrayed along the axial direction of the rotary inner cylinder, which is the wall part of the rotary inner cylinder, a large number of heating pipes which cause the gas to flow from one end to the other end in the axial direction to heat the medium passing the other channel are arrayed along the axial direction of the rotary outer cylinder, which is the wall part of the rotary outer cylinder, a convection of the medium is generated by so providing the medium with a temperature difference as to pass the one channel and the other channel, and motive power is obtained by turning the rotary inner cylinder and rotary outer cylinder with the convection of the medium.

This enables motive power to be obtained when heat is exchanged between gas and heating fluid. As a result, if this motive power is used for generating electricity with a generator, for instance, energy efficiency can be enhanced.

In another configuration of the apparatus for carbon dioxide recovery and combustion according to the invention, part of the gas discharged from the combustion unit is used as the heating fluid.

As part of the high temperature gas discharged from the combustion unit is directly used as the heating fluid, heating of the gas on the other channel can be more efficiently accomplished.

The apparatus for carbon dioxide recovery and combustion according to the invention enables gas discharged from the combustion unit to exchange heat with liquid nitrogen in the container of the carbon dioxide recovery unit and to be selectively recovered in a liquefied form and thereby enables carbon dioxide to be efficiently recovered.

Brief Description of the Drawings

Figure 1 is a diagram illustrating an apparatus for carbon dioxide recovery and combustion in a first mode for carrying out the present invention;

Figure 2 is a system diagram illustrating flows of various fluids in the carbon dioxide recovery unit of the apparatus for carbon dioxide recovery and combustion in the first mode for carrying out the invention;

Figure 3 is a diagram illustrating the carbon dioxide recovery unit of the apparatus for carbon dioxide recovery and combustion in the first mode for carrying out the invention;

Figure 4 is a diagram illustrating the combustion unit of the apparatus for carbon dioxide recovery and combustion in the first mode for carrying out the invention;

Figure 5 is a diagram illustrating an apparatus for carbon dioxide recovery and combustion in a second mode for carrying out the invention;

Figure 6 is a system diagram illustrating flows of various fluids in the carbon dioxide recovery unit of the apparatus for carbon dioxide recovery and combustion in the second mode for carrying out the invention;

Figure 7 is a diagram illustrating a gas-heating fluid heat exchanger of the apparatus for carbon dioxide recovery and combustion in the second mode for carrying out the invention;

Figure 8 is a diagram illustrating a modified version of the gas-heating fluid heat exchanger of the apparatus for carbon dioxide recovery and combustion in the second mode for carrying out the invention;

Figure 9 is a diagram illustrating the modified version of the gas-heating fluid heat exchanger of the apparatus for carbon dioxide recovery and combustion in the second mode for carrying out the invention, wherein a section along line A-A in Figure 8 is shown;

Figure 10 is a diagram illustrating the modified version of the gas-heating fluid heat exchanger of the apparatus for carbon dioxide recovery and combustion in the second mode for carrying out the invention, wherein a section along line B-B;

Figure 11 is a diagram illustrating an apparatus for carbon dioxide recovery and combustion in a third mode for carrying out the invention;

Figure 12 is a system diagram illustrating flows of various fluids in the carbon dioxide recovery unit of the apparatus for carbon dioxide recovery and combustion in the third mode for carrying out the invention;

Figure 13 is a diagram illustrating the carbon dioxide recovery unit of the apparatus for carbon dioxide recovery and combustion in the third mode for carrying out the invention;

Figure 14 is a diagram illustrating the carbon dioxide recovery unit of apparatus for carbon dioxide recovery and combustion in a fourth mode for carrying out the invention;

Figure 15 is a diagram illustrating the carbon dioxide recovery unit of the apparatus for carbon dioxide recovery and combustion in the fourth mode for carrying out the invention; and

Figure 16 is a diagram illustrating the gas-heating fluid heat exchanger the carbon dioxide recovery unit of the apparatus for carbon dioxide recovery and combustion in the fourth mode for carrying out the invention.

Description of Symbols

1	Carbon dioxide recovery unit
2	Combustion unit
5	Shell
6	Roof
7	Tower
8	Gas passage
8a	Air intake
9	Dew filter
10	Container
11	Cup
12	Inlet
13	Carbon dioxide suction pump
14	Carbon dioxide suction pipe
15	Carbon dioxide storage tank

16 Carbon dioxide takeout pipe
17 Carbon dioxide return pipe
17a Carbon dioxide injection ports
18 Liquid nitrogen injection pipe
20 Rotor
21 Cylinder
21a Water discharge hole
22 Gas sucking part
23 Gas discharging part
24 Tray
25 Ring
26 Blade
27 Rotor rotation shaft
30 Blast nozzles
31 Columnar body
32 Top plate
33 Side wall
34 Bearing
36 Ordinary part
37 Thick part
38 Projecting piece
40 Rotor driving means
41 Cylinder
42 Gas intake part
43 Gas discharge port
44 Guide plate
45 Bottom wall
46 Hole
47 Sealing member
50 Moving vane
51 Blade
55 Stationary vane
56 Blade
60 Turning force transmitting mechanism
61 First driving gear
62 First driven gear
63 First shaft

64	Second driving gear
65	Second driven gear
66	Second shaft
67	First transmission
68	Gear
69	Second transmission
70	Generator
80	Heating fluid scattering part
85	Heating fluid feeding part
86	Heating fluid circulation duct
87	Heating fluid heating part
88	Heating fluid recovery port
88a	Receptacle
89	Heating fluid suction pump
91	One end fulcrum shaft
91a	One end bearing
92	Communicating pipe
93	Roof cooling part
94	Water blow-out pipe
95	Heating fluid storage tank
100	Liquid nitrogen sprinkling part
101	Other end fulcrum shaft
101a	Other end fulcrum shaft bearing
110	Liquid nitrogen sprinkling part
111	Nitrogen circulation duct
112	Compressor
113	Condenser
114	Nitrogen chilling unit
115	Liquid nitrogen distribution duct
115a	Liquid nitrogen blow-out port
116	Nitrogen-carbon dioxide heat exchanger
117	Nitrogen turnaround duct
120	Fixed vane
125	Movable vane
200	Combustion chamber
201	Lower opening
202	Upper opening

203	Outer cylinder
204	Inner cylinder
205	Upper cylinder
206	Lower cylinder
207	Gas discharge port
210	Outside chamber
211	Upper side bearing
212	Lower side bearing
213	Exhaust space
230	Combustion chamber driving means
231	Power transmitting mechanism
232	Gear unit
233	Third shaft
234	Third driving gear
235	Third driven gear
240	Glass
250	Intermediate partitioning wall
251	Discharge passage
252	Cooling fluid passage
253	Inflow port
255	Cooling fluid feeding part
256	Cooling fluid storage tank
257	High pressure pump
258	Cooling fluid temporary storage tank
259	Inflow pipe
260	Cooling fluid outflow pipe
261	Cooling fluid injection pipe
261a	Cooling fluid injection ports
262	Glass cooling pipe
263	Warm water storage tank
264	Non-return valve
265	Flow rate regulating valve
267	Moisture separator
268	Duct
270	Oxygen feeder
271	Hydrogen feeder
272	Igniter

280 Fluid feed supplying part
281a First fluid feed storage tank
281b Second fluid feed storage tank
281c Third fluid feed storage tank
282 Fluid matter suction pump
283 Fluid matter primary storage tank
284 Fluid feed injector
285a, 285b, 285c Water feeding parts
286a, 286b, 286c Mixers
287 First spiral pipe
287a Electromagnetic valve
288a, 288b Water feeding pipes
289 Third transmission
290 Fourth transmission
291 Fifth transmission
292 Connecting pipe
294 Second spiral pipe
295 Third spiral pipe
300 Gas discharge pipe
301 Centrifuge
302 Hydrogen distribution pipe
303 Carbon dioxide distribution pipe
304 Gas distribution pipe
305 Water distribution pipe
306, 306a, 306b, 306c Gas-heating fluid heat exchanger
310 Lubricating oil circulation duct
314 Tower
315 Supply inlet
316 Discharge outlet
317 Rotary cylinder
318 Moving vane
318a First moving vane
319b Second moving vane
320 Spiral pipe
321 Convex striation
322 Rotary inner cylinder
323 Rotary outer cylinder

324 Guide vane
325 Cooling pipe
326 Heating pipe
327 Gear mechanism
328 Generator
R1 One channel
R2 Other channel
R3 One channel
R4 Other channel

Best Mode for Carrying Out the Invention

The apparatus for carbon dioxide recovery and combustion in a number of modes for carrying out the present invention will be described below with reference to the accompanying drawings.

Figure 1 and Figure 2 illustrate an apparatus for carbon dioxide recovery and combustion in a first mode for carrying out the present invention.

This apparatus for carbon dioxide recovery and combustion is equipped with a carbon dioxide recovery unit 1 and a combustion unit 2.

In the carbon dioxide recovery unit 1, carbon dioxide or a carbon dioxide-containing gas is fed into a container 10 and liquid nitrogen is also fed into the container 10 to cause heat exchange between carbon dioxide and liquid nitrogen in the container 10 to cause liquefaction of carbon dioxide.

In the combustion unit 2, into which fluid feed comprising a combustible substance mixed with water is fed, water in the fluid feed is pyrolyzed to burn the combustible substance and a carbon dioxide-containing gas after the combustion is discharged, and at least carbon dioxide in the gas is delivered into the container 10 of the carbon dioxide recovery unit 1.

In more detail, as shown in Figure 3, the carbon dioxide recovery unit 1, covered by a shell 5, has a configuration comprising the container 10 which allows liquefied carbon dioxide to be taken out from the bottom, a hollow rotor 20 which, disposed to be rotatable relative to the container 10, sucks gases, separates carbon dioxide, compressively collects it toward the outer circumference by centrifugal force, and blasts the separated and compressively collected carbon dioxide together with liquid nitrogen into the container 10 through a plurality of blast nozzles 30 disposed on the outer circumference to cause heat exchange between carbon dioxide and liquid nitrogen within the container 10 thereby to cause liquefaction of carbon dioxide, a rotor driving

means 40 which turns the rotor 20, a gas sucking part 22 which is disposed in the rotor 20 to suck gases, a gas discharging part 23 which is disposed in the rotor 20 to discharge unnecessary gases, a liquid nitrogen sprinkling part 100 which is disposed in the rotor 20 to sprinkle liquid nitrogen within the rotor 20, and a liquid nitrogen feeding part 110 which supplies liquid nitrogen to the liquid nitrogen sprinkling part 100.

The shell 5 is configured of a substantially conic roof 6 covering the space above the carbon dioxide recovery unit 1 and a cylindrical tower 7 covering the sides thereof. The shell 5 has an air intake 8a in the attic of the roof 6, and is provided with a gas passage 8 communicating with the gas sucking part 22.

The container 10 is configured of a hollow cup 11 covering the other end of a cylinder 41 to be described afterwards, and carbon dioxide is liquefied within the cup 11. The inner circumference of the upper part of the cup 11 is formed as an inlet 12 through which carbon dioxide and liquid nitrogen blasted out of the blast nozzles 30 of the rotor 20 enter into the cup 11.

A carbon dioxide suction pipe 14 for recovering liquefied carbon dioxide is connected to the cup 11. The carbon dioxide suction pipe 14 is provided with, on its route, a carbon dioxide suction pump 13 for sucking liquefied carbon dioxide and is connected to a carbon dioxide storage tank 15 for storing the sucked liquefied carbon dioxide. The carbon dioxide suction pump 13 is also provided with a carbon dioxide takeout pipe 16 for taking out the liquefied carbon dioxide.

A carbon dioxide return pipe 17 for returning carbon dioxide into the cup 11 is laid from the carbon dioxide storage tank 15. The carbon dioxide return pipe 17 is provided with a carbon dioxide injection port 17a through which carbon dioxide is injected onto a blade 41a disposed in the lower part of the cylinder 41.

When this apparatus is to be started, carbon dioxide is loaded back into the carbon dioxide storage tank 15 in advance from the carbon dioxide takeout pipe 16, and the cylinder 41 is turned by the injection from the carbon dioxide injection port 17a.

A liquid nitrogen injection pipe 18 for further blasting liquid nitrogen onto the carbon dioxide and liquid nitrogen blasted from the blast nozzles 30 of the rotor 20 is provided in the upper inside of the cup 11. The liquid nitrogen injection pipe 18 is connected to a nitrogen circulation duct 111 to be described

afterwards. An other end fulcrum shaft 101 on which the rotor 20 and the other end of the cylinder 41 pivot is disposed inside the bottom of the cup 11.

The other end fulcrum shaft 101 reaches the inside of the rotor 20 and also functions as the liquid nitrogen sprinkling part 100.

The rotor 20 is formed in a cylindrical shape having the gas sucking part 22 formed at one end in the direction of the rotation axis and the gas discharging part 23 formed at the other end in the direction of the rotation axis.

In further detail, the rotor 20 is provided with a cylinder 21, and the opening of this cylinder 21 toward one end in the direction of the rotation axis is the gas sucking part 22. The rotor 20 is further provided with a tray 24 provided with a bottom wall having a plane orthogonal to the direction of the rotation axis and having an opening toward one end of the rotor 20 in the axial direction, and a ring 25 disposed in parallel to the bottom wall of the tray 24 and above the outer circumference of the tray 24.

A plurality of the blast nozzles 30 are disposed between the outer edge of the tray 24 and the outer edge of the ring 25 and along these outer edges around the rotation axis of the rotor 20.

The opening of the tray 24 formed between the outer face of the cylinder 21 and the inner edge of the ring 25 is the gas discharging part 23.

Water discharge holes 21a are formed above the gas discharging part 23 of the cylinder 21, and water liquefied under cooling in the cylinder 21 is discharged outside the cylinder 21 through these water discharge holes 21a by a centrifugal force deriving from the turning of the rotor 20. A plurality of the water discharge holes 21a are arrayed along the circumference of the cylinder 21.

Within the tray 24, a plurality of blades 26 are arrayed around the axis of the rotor 20, and a plurality of the blades 26 centrifugally compresses gas flowing from the cylinder 21 to the gas discharging part 23.

A tubular rotor rotation shaft 27 to be inserted into the other end fulcrum shaft 101 to be described afterwards is disposed outside the bottom wall of the tray 24. This rotor rotation shaft 27 penetrates the top plate 32 of a columnar body 31 disposed at the bottom of the cup 11, and rotatably pivots on a bearing 34 disposed on this top plate 32.

The columnar body 31 is formed of the top plate 32 and a cylindrical side wall 33. The side wall 33 is fixed to the bottom of the cup 11.

The bearing 34 is provided with a tubular part 36 formed toward the other end in the axial direction and penetrating the top plate 32 of the columnar body

31, a tubular thick part 37 formed toward one end in the axial direction to a greater wall thickness than the tubular part 36, and a disk-like projecting piece 38 intervening between the tubular part 36 and the thick part 37 and protruding outward in the axial direction from the outer circumference of the thick part 37.

The rotor driving means 40 is provided with the cylinder 41, a moving vane 50, a stationary vane 55, a turning force transmitting mechanism 60, a heating fluid scattering part 80 and a heating fluid feeding part 85.

The cylinder 41, having a wall part outside the rotor 20, is disposed to be rotatable relative to the container 10 and the rotor 20. The cylinder 41 further has a gas intake part 42, disposed toward the other end in the direction of the rotation axis, to which gases from the gas discharging part 23 of the rotor 20 flow in, and a gas discharge port 43, disposed toward one end in the direction of the rotation axis, discharges outward gases having inflated inside.

The moving vane 50, disposed at the gas discharge port 43, receives gases discharged from the gas discharge port 43 and turns the cylinder 41. The stationary vane 55, disposed on the shell 5 covering the container 10 and the cylinder 41, receives gases discharged from the gas discharge port 43.

The turning force transmitting mechanism 60 links the turning force of the cylinder 41 with the turning force of the rotor 20. The heating fluid scattering part 80 scatters heating fluid between the rotor 20 and the cylinder 41. Further, a heating fluid feeding part 85 feeds the heating fluid to the heating fluid scattering part 80.

By the rotor driving means 40, gases are cooled on one channel R1 which reaches the gas discharging part 23 from the gas sucking part 22 of the rotor 20 via the inside of the rotor 20, and the gases are heated to create a gas flow on the other channel R2 which reaches the gas discharge port 43 of the cylinder 41 from the gas discharging part 23 of the rotor 20 via the outside of the rotor 20.

The other end of the cylinder 41, whose center is coaxial with the rotor 20, in the direction of the rotation axis is inserted into the open side of the cup 11. The cylinder 41 is provided with a guide plate 44, disposed toward one end of the axial direction, against which gases on the other channel R2 hit and which guides these gases outward in the direction of the rotation axis, and a bottom wall 45, disposed toward the other end in the axial direction, closes the other end opening of the cylinder 41. A hole 46 through which the rotor 20 is rotatably inserted is formed at the center of the guide plate 44. This hole 46 and the rotor 20 are rotatably sealed with a sealing member 47 in-between.

The guide plate 44 is formed with its outer circumferential edge curved toward the other end in the direction of the rotation axis.

The bearing 34 on which the rotor rotation shaft 27 pivots is disposed penetrating the center of the bottom wall of the cylinder 41. The bottom wall of the cylinder 41 is rotatably mounted on the projecting piece 38 and rotatably pivots on the thick part 37 of the bearing 34.

The moving vane 50 is configured of a plurality of arrayed blades 51 within the guide plate 44 around the rotation axis. The stationary vane 55 is configured of a plurality of arrayed blades 56 on the inner circumferential face of the tower 7 around the rotation axis. This arrangement enables a strong turning force on the cylinder 41 to be obtained via the moving vane 50 and the stationary vane 55 due to the forced and cooled compression of gases within the rotor 20 and the heated expansion of gases outside the rotor 20, and thereby enables a generator 70, to be described afterwards, to generate electric power.

The turning force transmitting mechanism 60 is provided with a first driving gear 61 disposed on the rotor rotation shaft 27, a first driven gear 62 meshing with the first driving gear 61, a first shaft 63 disposed coaxially with the first driven gear 62, a second driving gear 64 disposed on the outer side of the bottom wall 45 of the cylinder 41, a second driven gear 65 meshing with the second driving gear 64, a second shaft 66 disposed coaxially with the second driven gear 65, and a first transmission 67 formed of a gear box interlocking the first shaft 63 with the second shaft 66.

The first driving gear 61 and the first driven gear 62 are disposed inside the columnar body 31. The second driving gear 64 and the second driven gear 65 are disposed outside the columnar body 31. The first shaft 63 and the second shaft 66 are disposed penetrating the side wall 33 of the columnar body 31 and the cup 11 and rotatably pivot on the same via bearings.

Also, lubricating oil is kept in the cup 11. The lubricating oil also flows into the columnar body 31 through a hole bored in the side wall 33, and this lubricating oil lubricates not only the first driving gear 61 and the first driven gear 62 but also the second driving gear 64 and the second driven gear 65.

Further, the turning force transmitted by the first transmission 67 is also used as the motive power for the carbon dioxide suction pump 13 as this carbon dioxide suction pump 13 is connected to the first transmission 67 via a gear belt 68 to transmit the turning force of the cylinder 41.

The output shaft of the first transmission 67 is connected to a second transmission 69. The generator 70 is connected to this second transmission 69. The generator 70 is driven via the first transmission 67 and the second transmission 69 by the turning force of the cylinder 41 as the motive power.

The apparatus for carbon dioxide recovery and combustion in this mode for implementing the invention uses water as heating fluid.

The heating fluid scattering part 80 is formed in a cylindrical shape having a wall part outside the rotor 20, and is provided with a cylindrical member 81 on whose outer circumference a plurality of heating fluid blast nozzles 30 are formed. In the space between this cylindrical member 81 and the cylinder 21 of the rotor 20, a space in which heating fluid from the heating fluid feeding part 85 is caused to flow is formed.

The heating fluid feeding part 85 is provided with a heating fluid circulation duct 86 and heating fluid heating parts 87. The heating fluid circulation duct 86 recovers the heating fluid scattered in the cylinder 41 and circulates it in the heating fluid scattering part 80. Also, the heating fluid heating parts 87 heat, on the route of the heating fluid circulation duct 86, the heating fluid flowing in the heating fluid circulation duct 86.

The heating fluid circulation duct 86 is provided with a heating fluid suction pump 89 on its route, and this heating fluid suction pump 89 sucks water from a heating fluid recovery port 88 disposed in the cylinder 41. A receptacle 88a to receive the heating fluid scattered from the heating fluid scattering part 80 and having flowed down inside the cylinder 41 is disposed on the under side 88 of the heating fluid recovery port.

The heating fluid circulation duct 86 is provided with a one end fulcrum shaft 91 which protrudes toward one end of the cylinder 21 and is disposed rotatably on the roof 6 of the shell 5 and communicating pipes 92 which establish communication between the inside of this one end fulcrum shaft 91 and the inner space of the cylindrical member 81.

The one end fulcrum shaft 91 rotatably pivots on a one end fulcrum shaft bearing 91a disposed on the roof 6 of the shell 5.

A plurality of the communicating pipes 92 are disposed radially from the one end fulcrum shaft 91. An other end fulcrum shaft bearing 101a rotatably pivoting on the other end fulcrum shaft 101 is disposed on the communicating pipes 92 toward the under face of the one end fulcrum shaft 91.

The heating fluid suction pump 89, connected to the first transmission 67, can operate with the turning force of the cylinder 41 as the motive power.

The heating fluid heating parts 87 are disposed in a plurality of positions, one of which is configured of, for instance, a heat exchanger 87a which causes heat to be exchanged with the heating fluid by utilizing sunlight or geothermal energy. Other heating fluid heating parts 87 will be further described afterwards.

The heating fluid circulation duct 86 has, on its route, a roof cooling part 93 which passes the inside of the double-structured roof 6. This roof cooling part 93 also functions as the heating fluid heating parts 87 which absorb sunlight to heat the heating fluid within. The roof cooling part 93 cools the air on the surface side of the roof 6 to generate a downward air flow from the top toward the eaves of the roof 6. The heating fluid heating part 87 contributes to energy efficiency.

The heating fluid circulation duct 86 is also connected to a water blow-out pipe 94 having a water blow-out port 94a. Water flowing through the heating fluid circulation duct 86 is sprayed from the water blow-out port 94a onto a dew filter 9 disposed on the gas passage 8. The water blow-out pipe 94 is connected in a branched form to the upstream side and the downstream side of the heat exchanger 87a on the heating fluid circulation duct 86. And in the water blow-out pipe 94, cold water in the other channel R2 cooled by heat exchange and hot water heated by heat exchange in the heat exchanger 87a are mixed to provide warm water of a suitable temperature. This warm water is sprayed from the water blow-out port 94a onto the dew filter 9.

The liquid nitrogen sprinkling part 100 is configured of the other end fulcrum shaft 101. The other end fulcrum shaft 101 is formed in a tubular shape, on whose outer circumferential face a liquid nitrogen sprinkling port communicating from the inside to the outside is formed to blast outward the liquid nitrogen inside.

The liquid nitrogen feeding part 110 is provided with a nitrogen circulation duct 111 which recovers gasified nitrogen within the cup 11 and circulates the nitrogen in the liquid nitrogen sprinkling part 100, a compressor 112 which, disposed on the route of the nitrogen circulation duct 111, recovers and compresses gasified nitrogen within the cup 11, and a condenser 113 which chills and liquefies the nitrogen compressed by the compressor 112.

The compressor 112 is configured of a gaseous nitrogen suction pump. The gaseous nitrogen suction pump, connected to the first transmission 67, operates with the turning force of the cylinder 41 as the motive power. The condenser 113 performs heat exchange with water stocked in a heating fluid

storage tank 95 disposed on the route of the heating fluid circulation duct 86 farther upstream of the heat exchanger 87a, and also functions as the heating fluid heating part 87.

A nitrogen chilling unit 114 which chills nitrogen flowing in the nitrogen circulation duct 111 is also disposed on the route of the nitrogen circulation duct 111. As the nitrogen chilling unit 114, though not shown, an air cooling unit such a as a heat sink or a cooling fan or a water cooling unit which uses water as the coolant is used, for instance. Chilling by this nitrogen chilling unit 114 serves to reduce the load on the compressor 112 and enhance the power generation output.

The nitrogen circulation duct 111 is also connected to a liquid nitrogen distribution duct 115 which supplies liquid nitrogen in the nitrogen circulation duct 111 to the gas passage 8. A liquid nitrogen blow-out port 115a from which liquid nitrogen is blown out in the gas passage 8 is formed on the liquid nitrogen distribution duct 115.

The nitrogen circulation duct 111 is also provided with a nitrogen turnaround duct 117 to enable nitrogen to return to the nitrogen circulation duct 111 via a nitrogen-carbon dioxide heat exchanger 116 in which heat exchange between nitrogen and carbon dioxide on the route of the carbon dioxide return pipe 17 takes place.

In the nitrogen-carbon dioxide heat exchanger 116, while liquefied carbon dioxide is warmed by heat exchange with liquid nitrogen to become gasified, the liquid nitrogen is further chilled and returned to the nitrogen circulation duct 111.

Also, the other end fulcrum shaft 101 is provided with a fixed vane 120 which causes gas passing the one channel R1 in the rotor 20 to generate a vortex, and the inner wall of the rotor 20 is provided with a movable vane 125 which receives the gas made vortical by the fixed vane 120 and turns the rotor 20.

Further, as shown in Figure 1 and Figure 4, the combustion unit 2 is provided with a combustion chamber 200 which, in a state of being intercepted from air supply, is supplied with a fluid feed comprising a combustible substance mixed with water, burns the combustible substance by pyrolyzing the water in the fluid feed and discharges the gas having undergone combustion, a fluid feed supplying part 280 which supplies the fluid feed to the combustion chamber 200, an outside chamber 210 which surrounds the combustion chamber 200 and so supports the combustion chamber 200 as to

permit rotational driving, and a combustion chamber driving means 230 which rotationally drives the combustion chamber 200.

The combustion chamber 200 is provided, in its lower part, with a lower opening 201 which communicates with the combustion chamber 200 and guides the fluid feed in and, in its upper part, an upper opening 202 which communicates with the combustion chamber 200 and discharges exhaust. The combustion chamber 200 has an outer cylinder 203 and an inner cylinder 204; the inner cylinder 204 of the combustion chamber 200 consists of a heat resistant fluid which is pressed onto the outer cylinder 203 by the centrifugal force of the combustion chamber 200 to form the inner wall of the combustion chamber 200.

In further detail, the outer cylinder 203 is formed of tungsten (3407°C in melting point) for instance, while the inner cylinder 204 is formed of a ceramic, such as Sakurundum (2432°C in melting point). The ceramic which constitutes the inner cylinder 204 here is dissolved by the burning of the combustible substance and pressed onto the outer cylinder 203 by a centrifugal force to form the inner cylinder 204 of the combustion chamber 200. The dissolution of the ceramic serves to intercept the high temperature due to the combustion and obstruct its transmission to the outer cylinder 203, thereby enhancing the heat resistance of the combustion chamber 200. Incidentally, this ceramic is loaded from an upper cylinder 205 in a granular form before the combustion unit 2 is started, and is dissolved during the operation of the combustion unit 2 to form the inner cylinder 204. The temperature inside the combustion chamber 200 during combustion rises to a range of 1000°C to 7000°C, for instance. This high temperature causes pyrolysis of water into oxygen and hydrogen. At the center, where light rays intersect, the temperature may reach 70000°C. For this reason, even nuclear wastes such as depleted uranium can be disposed of.

The combustion chamber 200 is formed in a capsular shape, a lower opening 201 which communicates with the inside of the combustion chamber 200 and guides the fluid feed in is provided underneath the combustion chamber 200 while an upper opening 202 which communicates with the combustion chamber 200 and discharges the exhaust is provided above the combustion chamber 200. The upper cylinder 205 is disposed in line with the upper opening 202. Also, a lower cylinder 206 is disposed in line with the lower opening 201. At the base end of the upper cylinder 205, a gas discharge port 207 communicating with the upper opening 202 is formed.

Also, the outside chamber 210 is formed in a capsular shape. This outside chamber 210 is provided with an upper side bearing 211 on which the upper cylinder 205 pivots and a lower side bearing 212 on which the lower cylinder 206 pivots. Above the outside chamber 210, an exhaust space 213 which guides the exhaust from the gas discharge port 207 to a gas discharge pipe 300, to be described afterwards, is formed.

The combustion chamber driving means 230 is disposed underneath the outside chamber 210. The combustion chamber driving means 230 is also provided with a power transmitting mechanism 231 which transmits the turning force from the cylinder 41 to the combustion chamber 200 in linkage with the cylinder 41. The power transmitting mechanism 231 is equipped with a gear unit 232 which turns the combustion chamber 200 by rotationally driving the lower cylinder 206.

This gear unit 232 is provided with a third shaft 233 which, connected to the second transmission 69, is capable of transmitting the turning force of the cylinder 41 via the first transmission 67 and the second transmission 69, a third driving gear 234 disposed on a third shaft 233 and a third driven gear 235 which meshes with the third driving gear 234 and is disposed on the lower cylinder 206. The third shaft 233 rotatably pivots on the outside chamber 210 via a bearing 236.

Transparent glass 240, confronting the opening in the upper cylinder 205, is disposed on the ceiling of the outside chamber 210, and light rays generated within the combustion chamber 200 are taken out through this glass 240. The light rays taken out through the glass 240 are mainly used as laser beams, for instance. Though not shown, a detection sensor for detecting the temperature of light rays taken out through the glass 240 is disposed on the ceiling. As this detection sensor, a temperature sensor or a photoelectric tube sensor is used.

Further, a funnel-shaped discharge passage 251 for discharging out of the outside chamber 210 the ash content discharged from the lower opening 201 of the combustion chamber 200 is disposed underneath an intermediate partitioning wall 250 arranged between the outside chamber 210 and the combustion chamber 200. The space between the outside chamber 210 and the intermediate partitioning wall 250 is assigned as a cooling fluid passage 252 for the cooling fluid which cools the discharge passage 251 (cooling water in this mode for implementation) to pass. An inflow port 253 through which the cooling fluid flows in is disposed underneath the outside chamber 210. A

cooling fluid feeding part 255 which supplies the cooling fluid to the cooling fluid passage 252 is connected to the inflow port 253.

The cooling fluid feeding part 255 is provided with a cooling fluid storage tank 256 in which water, such as city water, is stored, a high pressure pump 257 which pumps the cooling fluid in the cooling fluid storage tank 256, a cooling fluid temporary storage tank 258 in which the cooling fluid from the high pressure pump 257 is temporarily stored, and an inflow pipe 259 which connects the cooling fluid temporary storage tank 258 and the inflow port 253.

A cooling fluid outflow pipe 260 from which the cooling fluid flows out is disposed underneath the outside chamber 210. The cooling fluid outflow pipe 260 is provided with a cooling fluid injection pipe 261 which blows water on the glass 240 from a cooling fluid injection port 261a disposed on the inner side of the outside chamber 210, and a glass cooling pipe 262 disposed branching into the cooling fluid injection pipe 261 and passing inside the glass 240. The cooling fluid outflow pipe 260 is connected downstream of the glass cooling pipe 262 to a warm water storage tank 263 in which water warmed by light rays from the combustion chamber 200 in the glass 240 is stored.

The warm water storage tank 263 is provided with a warm water outflow pipe 263a connected to the cooling fluid storage tank 256.

In the drawings, reference numeral 264 denotes a non-return valve which prevents the cooling fluid from flowing back, and 265, a flow rate regulating valve for regulates the flow rate of the cooling fluid flowing into the cooling fluid passage 252.

A plurality of jet holes 250a from which the cooling fluid flowing through the cooling fluid passage 252 jets out are bored in the intermediate partitioning wall 250. The cooling fluid having jetted out of the jet holes 250a is sprayed toward the combustion chamber 200 to cool the outer cylinder 203 of the combustion chamber 200 and flows down outside the outer cylinder 203. This flowing-down cooling fluid, together with the ash content, is discharged from the discharge passage 251 to outside the outside chamber 210. Meanwhile, water vaporized by the heat of the combustion chamber 200 is discharged from the gas discharge port 207.

The cooling fluid mixed with the ash content is centrifugally separated and taken out by a moisture separator 267. This moisture separator 267, disposed outside the outside chamber 210, separates moisture from the ash content discharged from the discharge passage 251 by, for instance, centrifugal separation. The moisture separator 267 is connected to the high

pressure pump 257 via a duct 268, and the water separated by this moisture separator 267 is sucked by the high pressure pump 257 via the duct 268.

This combustion unit 2 is also provided with an oxygen feeder 270 which feeds oxygen into the combustion chamber 200. The oxygen feeder 270 is equipped with an oxygen injection pipe which injects oxygen through the lower opening 201 of the combustion chamber 200. A hydrogen feeder 271 which feeds hydrogen into the combustion chamber 200 is also provided. The hydrogen feeder 271 is equipped with a hydrogen injection pipe which injects hydrogen through the lower opening 201 of the combustion chamber 200. The operation of the oxygen feeder 270 and the hydrogen feeder 271 is appropriately timed to start this apparatus or to stabilize the heating power, for instance.

In this mode for implementation, an igniter 272 for igniting the combustible substance fed to the combustion chamber 200 is provided. The igniter 272 is composed of an ignition plug disposed near the lower opening 201 of the combustion chamber 200.

The fluid feed supplying part 280 is equipped with a plurality of fluid feed storage tanks 281a, 281b and 281c differentiated by the type of feed, a fluid feed suction pump 282 which sucks a fluid feed from the lower part of the fluid feed storage tank 281a, 281b or 281c, a fluid feed temporary storage tank 283 which temporarily stores the fluid feed sucked by this fluid feed suction pump 282, and a fluid feed injector 284 which injects the fluid feed stocked in the fluid feed temporary storage tank 283 into the combustion chamber 200.

Three fluid feed storage tanks are provided in this mode for implementation, including the first fluid feed storage tank 281a to contain plastics, worn-out tires, livestock’s raw sewage or the like as the combustible substance, the second fluid feed storage tank 281b to contain waste oils including PCB as the combustible substance, and the third fluid feed storage tank 281c to contain depleted uranium (uranium 238) as the combustible substance.

These fluid feed storage tanks 281a, 281b and 281c, each having in its upper part an opening through which the combustible substance is loaded, store the fluid feeds loaded through these openings. Water is fed from water feeding parts 285a, 285b and 285c for feeding water into the fluid feed storage tanks 281a, 281b and 281c, and the combustible substances and water, mixed by mixers 286a, 286b and 286c for stirring the contents of the fluid feed storage

tanks 281a, 281b and 281c, to provide fluid feeds each consisting of a combustible substance and water.

In the first fluid feed storage tank 281a, a first spiral pipe 287 is arranged from its lower to upper part. The first spiral pipe 287, arranged in the heating fluid circulation duct 86 side by side with the heating fluid storage tank 95, cools the fluid feed by having it exchange heat with the heating fluid cooled by the other channel R2. It further functions as the heating fluid heating part 87 to heat the heating fluid. An electromagnetic valve 287a to regulate the flow rate of the heating fluid flowing through the first spiral pipe 287 is disposed at the point where this first spiral pipe 287 branches out from the heating fluid storage tank 95 on the upstream side.

The water feeding part 285a which feeds water to the first fluid feed storage tank 281a comprises a water feeding pipe 288a which collects water having flowed down from the dew filter 9 and feeds it to the first fluid feed storage tank 281a and a water feeding pipe 288b to which water from the warm water storage tank 263 and water branched out of a water distribution pipe 305 to be described afterwards are fed. The water feeding pipes 288a and 288b are equipped with valves for regulating the flow rates of water flowing within.

The mixer 286a disposed in the first fluid feed storage tank 281a, linked to a third transmission 289 disposed on the third shaft 233, operates with the turning force of the cylinder 41 as the motive power. And this mixer 286a operates in a state in which the motive power from the third transmission 289 is variable on the basis of the temperature detected by a temperature detection sensor disposed on the first fluid feed storage tank 281a.

In the second fluid feed storage tank 281b, a second spiral pipe 294 is arranged from its lower to upper part. The second spiral pipe 294, disposed on the route of the gas discharge pipe 300 to be described afterwards, exchanges heat with the gas flowing in the gas discharge pipe 300 to heat the fluid feed and cools the gas.

The water feeding part 285b which feeds water to the second fluid feed storage tank 281b comprises the warm water storage tank 263 and a water feeding pipe 288c to which water branched out of the water distribution pipe 305 to be described afterwards is fed. This water feeding pipe 288c is equipped with a valve for regulating the flow rate of water flowing within.

The mixer 286b disposed in the second fluid feed storage tank 281b, linked to a fourth transmission 290 disposed on the third shaft 233, operates with the turning force of the cylinder 41 as the motive power. And this mixer

286b operates in a state in which the motive power from the fourth transmission 290 is variable on the basis of the temperature detected by a temperature detection sensor disposed on the second fluid feed storage tank 281b.

Further in the third fluid feed storage tank 281c, a third spiral pipe 295 is disposed on the route farther upstream than a cooling fluid jet pipe of the cooling fluid outflow pipe 260 from the lower to upper part of the third fluid feed storage tank 281c. In the third spiral pipe 295, the fluid feed is cooled by heat exchange between the fluid feed from the third fluid feed storage tank 281 and the cooling fluid.

The water feeding part 285c which feeds water to the third fluid feed storage tank 281c consists of a water feeding pipe 296 which is disposed downstream of the third spiral pipe 295 of the cooling fluid outflow pipe 260 and feeds the cooling fluid to the third fluid feed storage tank 281c as water. This water feeding pipe 296 is equipped with a valve for regulating the flow rate of water flowing within.

The mixer 286c, disposed in the third fluid feed storage tank 281c is linked to the second transmission 69, operates with the turning force of the cylinder 41 as the motive power. And this mixer 286c operates in a state in which the motive power from the second transmission 69 is variable on the basis of the temperature detected by a temperature detection sensor disposed on the third fluid feed storage tank 281c.

The fluid feed suction pump 282 is connected to three-branched connecting pipes 292, and the connecting pipes 292 are connected to the fluid feed storage tanks 281a, 281b and 281c. These branched connecting pipes 292 are equipped with flow rate regulating valves 292a, 292b and 292c so as to regulate the ratios of combustible substances contained in the fluid feeds in the merged pipes. The apertures of these valves 292a, 292b and 292c are controlled on the basis of the temperatures of light rays radiated from the glass 240 detected by temperature detection sensors, and the temperature within the combustion chamber 200 is thereby controlled within the bearable range of the combustion chamber 200. The energy ranking of the combustible substances loaded in the fluid feed storage tanks 281a, 281b and 281c is the combustible substance loaded in the first fluid feed storage tank 281a < that in the second fluid feed storage tank 281b < that in the third fluid feed storage tank 281c.

The fluid feed injector 284 is formed in a tubular shape which is inserted into the lower cylinder 206 and has a fluid feed injection port 284a formed at the tip. A drill 284b is formed on the outer circumference of the fluid feed

injector 284. With this drill 284b, the ash content deriving from combustion in the combustion chamber 200 and having reached the lower cylinder 206 is scraped out toward the discharge passage.

This combustion unit 2 is also equipped with the gas discharge pipe 300 which is connected to the exhaust space 213 disposed above the outside chamber 210 and through which the gas discharged from the gas discharge port 207 passes. A centrifuge 301 is disposed on the route of the gas discharge pipe 300.

The centrifuge 301 performs separation into hydrogen, carbon dioxide, other gases such as ozone, water vapor and so forth. The centrifuge 301 is connected to a gas distribution pipe 304 and a water distribution pipe 305. Hydrogen flows in a hydrogen distribution pipe 302, carbon dioxide flows in a carbon dioxide distribution pipe 303, other gases flow in the gas distribution pipe 304, and vaporized water flows in the water distribution pipe 305.

The hydrogen having flowed through the hydrogen distribution pipe 302, after passing the gas passage 8 in the attic of the roof of the carbon dioxide recovery unit 1, is compressed by a hydrogen compressor 352. The hydrogen compressor 352 is connected by a duct to the high pressure pump 257, and the water generated by this hydrogen compressor 352 is sucked by the high pressure pump 257 via the duct.

In the gas passage 8, the hydrogen distribution pipe 302 is formed in an annular shape centering on the rotation axis, and the annular part of the hydrogen distribution pipe 302 is sprayed with liquid nitrogen from the liquid nitrogen distribution duct 115 to cool the hydrogen within.

The carbon dioxide distribution pipe 303 supplies carbon dioxide into the gas passage 8. In more detail, the carbon dioxide distribution pipe 303 is formed in an annular shape centering on the rotation axis within the gas passage 8. And there is provided a carbon dioxide delivery port through which carbon dioxide is delivered toward the inner circumference of this annular part.

The water distribution pipe 305 is connected to the warm water storage tank 263.

Water from the water distribution pipe 305 flows into the warm water storage tank 263, the first fluid feed storage tank 281a and the second fluid feed storage tank 281b. Thus, when water is insufficient in the first fluid feed storage tank 281a and the second fluid feed storage tank 281b, the valve apertures of the water feeding pipes 288b and 288c are expanded, and water from the warm water storage tank 263 also flows into the water feeding pipes.

Or when water is sufficient in the first fluid feed storage tank 281a and the second fluid feed storage tank 281b, the valve apertures of the water feeding pipes 288b and 288c are narrowed, and water from the water distribution pipe 305 also flows into the warm water storage tank 263.

Further, the gas discharge pipe 300 is equipped on its route a gas-heating fluid heat exchanger 306 which causes heat exchange with the heating fluid of the heating fluid circulation duct 86 as the heating fluid heating part 87. This gas-heating fluid heat exchanger 306 is disposed in a heating fluid storage tank 307 connected to the heating fluid circulation duct 86 upstream of the heat exchanger 87a and to the heating fluid circulation duct 86 on the downstream side, and has a plurality of thin tubes 308 which branch out of the gas discharge pipe 300.

This gas discharge pipe 300 is also equipped with a power turbine 308 on the route of the gas discharge pipe 300 from the outside chamber 210 to the gas-heating fluid heat exchanger 306. This power turbine 308 generates power with the gas flowing in the gas discharge pipe 300.

The apparatus for carbon dioxide recovery and combustion according to the invention is also provided with the cup 11, the bearing 236 on which the third shaft 233 pivots, the gear unit 232, the lower side bearing 212, the upper side bearing 211 and a lubricating oil circulation duct 310 which supplies lubricating oil to the one end fulcrum shaft bearing 91a in a circulatory process. This lubricating oil circulation duct 310 has a lubricating oil suction pump 311 which sucks oil within the cup 11 and delivers it towards the bearing 236 on the route between the cup 11 and the bearing 236 on which the third shaft 233 pivots. The lubricating oil suction pump 311 is connected to the third transmission 289 and operates with the turning force of the cylinder 41 as the motive power.

Further, a lubricating oil cooler 312 for cooling the lubricating oil warmed by the heat arising from rotations in various positions is disposed on the route between the upper side bearing 211 and the one end fulcrum shaft 91. This lubricating oil cooler 312 consists of a spiral pipe arranged from the upper to lower part within the cooling fluid storage tank 256.

Incidentally, the whole piping is covered with heat insulating members, though not shown, to prevent thermal energy from being discharged into the air. All the power transmission mechanisms and variable transmissions are designed to turn at their respectively efficient frequencies.

Therefore, when wastes are to be burnt while recovering carbon dioxide with the apparatus for carbon dioxide recovery and combustion in this mode for implementation, the following process takes place.

The carbon dioxide recovery unit 1, using the carbon dioxide return pipe 17, gasifies with the nitrogen-carbon dioxide heat exchanger 116 the carbon dioxide stored in the carbon dioxide storage tank 15 in advance, and injects this gasified carbon dioxide from the carbon dioxide injection port 17a. When this take place, the carbon dioxide injected from the carbon dioxide injection port 17a hits against the blade 41a disposed on the cylinder 41, and the cylinder 41 is thereby turned.

Next in the carbon dioxide recovery unit 1, gas on one channel R1 is cooled by liquid nitrogen from the liquid nitrogen sprinkling part 100 while the heating fluid scattering part 80 heats gas on the other channel R2. When this takes place, the gas on one channel R1 is cooled with the liquid nitrogen and descends and, when it is discharged from the gas discharging part 23, is discharged in a state in which a vortex has been generated by the blades 26.

Also, the gas which has flowed out of the gas discharging part 23 into the cylinder 41 through the gas intake part 42 exchanges heat with the heating fluid from the heating fluid scattering part 80, and the heated gas ascends. And, when the gas ascending on the other channel R2 hits against the guide plate 44 and flows out through the gas discharge port 43, this gas hits against the blades 26 of the moving vane 50 to turn the cylinder 41 and at the same time is blasted on the stationary vane 55. The repulsive force deriving from this blasting also works to turn the cylinder 41.

In the cylinder 41 turned then, the heating fluid cooled by the heat exchange with the gas on the other channel R2 is pressed by the centrifugal force against the inner wall of the cylinder 41 and stays there, and recovered into the heating fluid circulation duct 86 through the heating fluid recovery port 86.

On one channel R1 then, the gas on one channel R1 is made vortical by the fixed vane 120, and this vortical gas hits against the movable vane 125 to further turn the rotor 20. Thus, since not only the cylinder 41 but also the movable vane 125 provides a turning force to the rotor 20, the rotor 20 can be turned more efficiently and faster, enabling the carbon dioxide to be centrifugally compressed in a satisfactory way.

And when the rotation of the cylinder 41 is stabilized, the injection of carbon dioxide from the carbon dioxide injection port 17a stops.

When the cylinder 41 turns, the rotor 20 linked to the cylinder 41 by the turning force transmitting mechanism 60 also turns. When the rotor 20 turns, a sucking force deriving from a plurality of the blades 26 disposed on the tray 24 of the rotor 20 works on the rotor 20, and air of the gas passage 8 from the gas sucking part 22 overlooking the gas passage 8 and carbon dioxide from the carbon dioxide distribution pipe 303 are let in.

The gas sucked into the rotor 20 is cooled on one channel R1 by the sprinkled liquid nitrogen and carbon dioxide is made misty. When the gas proceeds farther on one channel R1 and enters the tray 24 toward the other end of the rotor 20, the gas containing this misty carbon dioxide is centrifugally compressed, resulting in compressive collection of separated carbon dioxide and liquid nitrogen toward the outer circumference; the carbon dioxide and the liquid nitrogen are blasted from the blast nozzles 30 and unnecessary gases in the rotor 20 are guided to the gas discharging part 23 to be discharged. And the carbon dioxide and the liquid nitrogen having been blasted from the blast nozzles 30 and reached the inside of the container 10 are subjected to liquid nitrogen-carbon dioxide heat exchange within the container 10 by liquid nitrogen injected from the liquid nitrogen injection pipe 18.

This heat exchange advances the liquefaction of carbon dioxide and the liquefied carbon dioxide flows down the container 10 and sucked by the liquefied carbon dioxide suction pump 13 from the bottom of the container 10, while liquid nitrogen is gasified and sucked by the nitrogen suction pump. This causes carbon dioxide to be separated and compressively collected toward the outer circumference of the rotor 20 and, as only this compressively collected carbon dioxide is liquefied, a minute quantity of carbon dioxide in the air is liquefied selectively and efficiently. The liquefied carbon dioxide of the container 10 liquefied in the container 10 is sucked by the carbon dioxide suction pump 13, taken out and stored into the carbon dioxide storage tank 15.

Further, in this case as not only the turning force of the cylinder 41 turns the rotor 20 but also gas flows on one channel R1 and the other channel R2 work to turn the rotor 20, unlike in a case in which a motor or the like is used to turn the rotor 20, carbon dioxide can be recovered with scarce use of motive power from outside, and energy efficiency can be accordingly enhanced.

Also, in the gas passage 8 of the carbon dioxide recovery unit 1, as gas passing the gas passage 8 is cooled by liquid nitrogen from the liquid nitrogen blow-out port 115a, water from the water blow-out port 94a wets the dew filter 9 and the gas cooled by this dew filter 9 passes, water vapor in the gas is

liquefied and sticks to the dew filter 9. As a result, dry gas containing relatively little water vapor is sucked by the gas sucking part 22, making it difficult for moisture to be contained in the carbon dioxide centrifugally separated by the rotor 20.

Further, the liquid nitrogen feeding part 110 feeds the condenser 113 with nitrogen gasified under driving by the compressor 112, the condenser 113 chills and liquefies the nitrogen, the nitrogen liquefied by the condenser 113 is chilled by the nitrogen chilling unit 114 and is supplied to the liquid nitrogen sprinkling part 100. The liquid nitrogen sprinkling part 100 sprinkles the chilled liquid nitrogen from the liquid nitrogen sprinkling port of the other end fulcrum shaft which is the liquid nitrogen sprinkling part 100.

On the other hand in the combustion unit 2, fluid feed is put into the fluid feed storage tank. This fluid feed is adjusted in moisture to an appropriate level with water from a water feeding part and stirred with a mixer. As a result, the fluid feed is homogenized and smoothly burnt in the combustion chamber 200. As the mixer is operated by the turning force of the cylinder 41, higher energy efficiency can be achieved than in a case in which a separate motor is provided to operate the mixer.

Further, the combustion chamber 200 is operated by the power transmitting mechanism 231 of the combustion chamber driving means 230 with the turning force of the rotor 20 as the motive power. Oxygen and hydrogen are supplied into the combustion chamber 200 in a rotating state from the oxygen feeder 270 and the hydrogen feeder 271, the ignition plug of the igniter 272 is actuated, and the combustion of hydrogen by oxygen raises the temperature to a high level. When ceramic particles are put in from the upper cylinder 205, the ceramic is dissolved by the combustion of hydrogen and pressed against the outer cylinder 203 by a centrifugal force to form the inner cylinder 204.

When the fluid feed suction pump of the fluid feed supplying part 280 is operated in this state, fluid feeds stored in the first fluid feed storage tank 281a, the second fluid feed storage tank 281b and the third fluid feed storage tank 281c are sucked, stored in the fluid feed temporary storage tank 283, and injected from the fluid feed temporary storage tank 283 into the combustion chamber 200 via the fluid feed injector 284. This causes water in the fluid feeds to be pyrolyzed into oxygen and hydrogen, and the combustible substance is burnt with this oxygen and oxygen fed from the oxygen feeder 270. When the combustion settles down into a stationary state, the oxygen feeder

270 and the hydrogen feeder 271 stop operating. To stabilize the combustion, the igniter 272, the oxygen feeder 270 and the hydrogen feeder 271 are operated at appropriate timings.

In the combustion chamber 200, a rising vortex is generated in the stationary state, the temperature and pressure rise to high levels in the combustion chamber 200, water in the fluid feed turns into pyrolyzed oxygen, and this oxygen subjects the combustible substance to substantially complete combustion. Thus in this process, a centrifugal force deriving from the fast rotation of the combustion chamber 200 causes the dissolved ceramic to take on a cylindrical shape in the combustion chamber 200, infrared rays are reflected back and forth on the inner face of this dissolved ceramic cylinder and make it difficult for more infrared rays to come out of the gas discharge port 207, resulting extremely high temperature and substantially complete combustion. Within the combustion chamber 200, hydrogen, carbon dioxide, water vapor, superfluous oxygen and other gases are generated, and discharged from the gas discharge pipe 300. This exhaust drives the power turbine 308 for use in power generation or some other purpose.

Since the combustion chamber 200 then rotates with the turning force of the cylinder 41 as the motive power, higher energy efficiency can be achieved than in a case in which a separate motor or the like is provided to rotate the combustion chamber 200.

Further, as the fluid feed contains depleted uranium (uranium 238) and this depleted uranium is burnt in the combustion chamber 200, the temperature in the combustion chamber 200 further rises. Also, the higher temperature in the combustion chamber 200 facilitates decomposition of harmful waste oils such as PCB.

Meanwhile, the gas having reached the gas discharge pipe 300 from the gas discharge port 207 passes the gas-heating fluid heat exchanger 306 on the route of the gas discharge pipe 300. Here, the gas in the gas discharge pipe 300 exchanges heat with the heating fluid in the heating fluid storage tank, further passes the second spiral pipe 294 downstream, exchanges heat with waste oil in the second fluid feed storage tank 281b, and reaches the centrifuge 301.

In the gas-heating fluid heat exchanger 306 then, as the heating fluid is heated by utilizing the exhaust heat of the gas generated when the combustible substance is burnt in the combustion unit 2, energy can be more effectively

utilized than in a case in which a separate heating unit for heating the heating fluid is provided.

In the gas discharge pipe 300 downstream, as waste oil which is the fluid feed within the second fluid feed storage tank 281b is heated and injected from the fluid feed injector 284, thermal efficiency is high, and combustion can be correspondingly more secure.

Since the cooling fluid is sprayed on the outer cylinder 203 of the combustion chamber 200 to cool the outer cylinder 203 even if the outer cylinder 203 is raised to high temperature by combustion within the combustion chamber 200, dissolution of the outer cylinder 203 can be prevented.

On the other hand, gas is cooled by the gas-heating fluid heat exchanger 306 and the second spiral pipe 294, separated into hydrogen, carbon dioxide, other gases and water and recovered by the gas centrifuge 301. In this case, as air supply to the combustion chamber 200 is intercepted, the supply of nitrogen is scarce, resulting in restraint on the generation of nitrogen oxides other than those attributable to combustible substances. As a result, exhaust gas is made clean and its recovery facilitated.

Out of the gases from the combustion chamber 200, carbon dioxide separated by the centrifuge 301 is fed to the gas passage 8 of the carbon dioxide recovery unit 1.

The carbon dioxide from the combustion unit 2 having entered the gas passage 8, together with the carbon dioxide in the atmosphere, is liquefied in the container 10 of the carbon dioxide recovery unit 1 and recovered as carbon dioxide. Since carbon dioxide is thus recovered even more selectively, the efficiency of recovery is enhanced. Unlike conventional combustion units, since this combustion unit allows carbon dioxide to be taken out in a liquefied state, the handling of carbon dioxide can be diversified.

Further, the ash content generated in the combustion chamber 200 drops to the lower part of the combustion chamber 200 and discharged from the discharge passage 251. In this process, the discharge passage 251 is cooled by the cooling fluid flowing in the cooling fluid passage 252.

The ash content discharged from the discharge passage 251 reaches the moisture separator 267, where moisture is separated from the ash content and discharged as sludge. The quantity of sludge in this case is much smaller than that of the fluid feeds to be treated, and the subsequent treatment is made correspondingly easier.

The generator 70 generates electricity with motive power consisting of the remainder of the subtraction of the power used for operation of the rotor 20, the combustion chamber 200, various pumps and mixers from the turning force of the cylinder 41. Furthermore, the turning force of the cylinder 41 can be exhaustively utilized, resulting in greater energy efficiency.

Next, Figure 5 and Figure 6 show an apparatus for carbon dioxide recovery and combustion in a second mode for carrying out the invention.

This apparatus for carbon dioxide recovery and combustion differs from that in the first mode for implementation in the structure of the gas-heating fluid heat exchanger 306.

As shown in Figure 7, a gas-heating fluid heat exchanger 306a is provided with a tower 314 for enclosing a medium consisting of a gas for heat exchange (for instance, carbon dioxide) and a rotary cylinder 317 rotatably pivoting on the tower 314, having a medium supply inlet 315 at one end and a medium discharge outlet 316 at the other end in the axial direction. As this results in the formation in the heat exchanger 306a of one channel R3 which reaches the discharge outlet 316 from the supply inlet 315 of the rotary cylinder 317 via the inside of the rotary cylinder 317 and the other channel R4 which reaches the supply inlet 315 from the discharge outlet 316 of the rotary cylinder 317 via the outside of the rotary cylinder 317.

Further, the rotary cylinder 317 is provided with a first moving vane 318a which receives a medium flowing through the supply inlet 315 into the rotary cylinder 317 and gives a turning force to the rotary cylinder 317 and a second moving vane 318b which receives a medium discharged from the discharge outlet 316 and gives a turning force to the rotary cylinder 317. Within the rotary cylinder 317, a spiral pipe 320 which distributes the heating fluid toward one end from the other end in the axial direction and cools the medium passing through one channel R3 is disposed. Further in the wall part of the tower 314, a convexly striated pipe 321 which distributes the gas from one end toward the other end in the axial direction, is spiral in the reverse direction to the spiral pipe 320 and heats the medium passing the other channel R4 is disposed.

When the gas from the gas discharge pipe 300 and the heating fluid from the heating fluid circulation duct 86 are delivered in this gas-heating fluid heat exchanger 306a, the medium on one channel R3 is cooled by heat exchange with the heating fluid of the spiral pipe 320, and the medium on the other channel R4 is heated by heat exchange with the convexly striated pipe 321, resulting in convection of the media passing one channel R3 and the other

channel R4. The convection of the media turns the rotary cylinder 317, and the turning force of the rotary cylinder 317 is obtained as the motive power via a gear mechanism 327. This motive power drives a generator 328.

In this way, motive power can be obtained when heat is exchanged between gas and heating fluid to make possible power generation, resulting in corresponding energy efficiency.

Other aspects of configuration, actions and effects are the same as those in the first mode for implementation.

Further, Figure 8 through Figure 10 show an application of the heat exchanger of the apparatus for carbon dioxide recovery and combustion in a second mode for implementation. Similar elements to their counterparts in the gas-heating fluid heat exchanger 306a are designated by respectively the same reference symbols.

This gas-heating fluid heat exchanger 306b is equipped with the tower 314, a rotary inner cylinder 322 rotatably pivoting on the tower 314, having a medium supply inlet 315 for a medium consisting of a gas for heat exchange (for instance, carbon dioxide) at one end and a medium discharge outlet 316 at the other end in the axial direction, and a rotary outer cylinder 323 which is rotatably provided on the tower 314 and the rotary inner cylinder 322, whose wall part is positioned between the tower 314 and the rotary inner cylinder 322, and which seals in the medium.

In this way in the gas-heating fluid heat exchanger 306b, one channel R3 which reaches the discharge outlet 316 from the supply inlet 315 of the rotary inner cylinder 322 via the inside of the rotary inner cylinder 322 and the other channel R4 which reaches the supply inlet 315 from the discharge outlet 316 of the rotary inner cylinder 322 via the outside of the rotary inner cylinder 322 are formed.

Toward one end of the rotary inner cylinder 322, a moving vane 318 which receives a medium flowing into the supply inlet 315 and gives a turning force to the rotary inner cylinder 322 is disposed, and a guide vane 324 which guides the medium to the moving vane 318 and gives a turning force to the rotary outer cylinder 323 is disposed on the inner circumference toward one end of the rotary outer cylinder 323. The curvature and blowing direction of this guide vane 324 are freely set in designing to match the temperature difference, the frequency of rotation and the inner pressure to enhance efficiency.

In the wall part of the rotary inner cylinder 322, a large number of cooling pipes 325 which distribute the heating fluid toward one end from the other end in the axial direction and cool the medium passing one channel R3 are arrayed in the axial direction of the rotary inner cylinder 322. Meanwhile in the wall part of the rotary outer cylinder 323, a large number of heating pipes 326 which distribute the gas from one end toward the other end in the axial direction and heat the medium passing the other channel R4 are arrayed in the axial direction of the rotary outer cylinder 323.

When the gas from the gas discharge pipe 300 and the heating fluid from the heating fluid circulation duct 86 are delivered in this gas-heating fluid heat exchanger 306b, the medium on one channel R3 is cooled by heat exchange with the heating fluid of the cooling pipes 325, and the medium on the other channel R4 is heated by heat exchange with the gas on the heating pipes 326, resulting in convection of the media passing one channel R3 and the other channel R4. The convection of the media turns the rotary inner cylinder 322 and the rotary outer cylinder 323, and the turning forces of the rotary inner cylinder 322 and the rotary outer cylinder 323 are obtained as the motive power via the gear mechanism 327.

As this gas-heating fluid heat exchanger 306b, unlike the foregoing gas-heating fluid heat exchanger 306a, derives motive power not only from the rotary inner cylinder 322 which corresponds to the rotary cylinder 317 but also from the rotary outer cylinder 323, the efficiency of motive acquisition can be enhanced.

Other aspects of configuration, actions and effects are the same those in the first mode for implementation.

Next, Figure 11 through Figure 13 show an apparatus for carbon dioxide recovery and combustion in a third mode for carrying out the invention.

This apparatus for carbon dioxide recovery and combustion, unlike the foregoing apparatus, uses part of the gas discharged from the combustion unit 2 as the heating fluid.

In more detail, in the carbon dioxide recovery unit 1, the gas discharge pipe 300 is connected to the one end fulcrum shaft 91 via a case 340 covering one end of the one end fulcrum shaft 91 in the axial direction. Toward one end of the one end fulcrum shaft 91 in the axial direction, a blade 330 which generates a vortex in the case 340 is disposed. Further, the space between the outer side face of the cylinder 21 and the inner side face of the cylindrical member 81 is separated into two outer and inner spaces 332 and 333 in the

axial direction by a cylindrical partitioning 331 disposed coaxially with the rotation axis. And two upper and lower pipes 334 and 335 are connected to the one end fulcrum shaft 91 at the other end in the axial direction. Of these two, the upper pipe 334 communicates with the inner space 332 separated by the partitioning 331 in the axial direction. The lower pipe 335 communicates with the outer space 333 separated by the partitioning 331 in the axial direction.

Further, toward the other end of the rotor 20 in the direction of the rotation axis, a gas delivery duct 336 for delivering the gas in the space 332 is disposed from the inner space separated by the partitioning 331 in the axial direction to the upper vicinities of the blast nozzles 30. The gas having flowed in the outer space separated by the partitioning 331 in the axial direction is scattered toward the cylinder 41 from a heating fluid scattering port disposed in the surface of the cylindrical member 81.

Furthermore, on the axis of the one end fulcrum shaft 91, a hydrogen suction pipe 350 having a plurality of hydrogen suction ports capable of sucking hydrogen is disposed. The hydrogen suction pipe 350 is connected to a hydrogen storage tank 351 for storing sucked hydrogen, and is provided on its route with a hydrogen compressor 352, whose operation causes hydrogen to be sucked through the hydrogen suction ports. Part of the hydrogen suction pipe 350 passes to the gas passage 8 in the attic of the roof. The hydrogen suction pipe 350 is formed in an annular shape centering on the rotation axis in the gas passage 8, and liquid nitrogen from the liquid nitrogen distribution duct 115 is blown on this annular part to cool the hydrogen within.

The hydrogen suction pipe 350 is provided with a hydrogen supply pipe 353 connected to the fluid feed primary storage tank 283 closer toward the hydrogen storage tank 351 than the annular part. This hydrogen supply pipe 353 supplies hydrogen to the fluid feed primary storage tank 283.

Further, a heating fluid delivery duct 86a is provided in place of the heating fluid circulation duct 86. The heating fluid delivery duct 86a differs from the heating fluid circulation duct 86 in the part farther downstream than the heating fluid storage tank 95, where it is connected to the warm water storage tank 263.

Other aspects of configuration are the same as in the foregoing modes for implementation.

This apparatus for carbon dioxide recovery and combustion is operated in the same way as the foregoing apparatuses.

And gases discharged from the combustion unit 2 reach the carbon dioxide recovery unit 1 via the gas discharge pipe 300, are turned into a vortex in the case 340 and flow into the one end fulcrum shaft 91 in the vortical form.

Among the gases made vortical, those smaller in specific gravity are centrifugally separated inward relative to the axial direction of the one end fulcrum shaft 91, while those greater in specific gravity are separated outward in the axial direction. Hydrogen, which is smaller in specific gravity is distributed toward the axis of the one end fulcrum shaft 91 and sucked through the hydrogen suction pipe 350.

Gases having high contents of carbon dioxide, which is greater in specific gravity, are distributed outward relative to the direction of the rotation axis, mainly flow into an upper pipe disposed toward the other end of the one end fulcrum shaft 91 in the axial direction, and only carbon dioxide is compressively collected in the space by the centrifugal force deriving from the rotation of the rotor 20; only carbon dioxide is blasted into the container 10 from the gas delivery duct while other gases than carbon dioxide reach the gas discharge port from the gas intake part 42 via the other channel R2. The carbon dioxide from the combustion unit 2 scattered into the container 10, together with the carbon dioxide blasted from the blast nozzles 30 in the same way as the foregoing, is liquefied in the container 10 and recovered.

Other gases relatively small in specific gravity, such as water vapor, are distributed inward relative to the direction of the rotation axis, flow into a pipe disposed underneath, and are scattered as heating fluid from the heating fluid scattering port onto the gas of the other channel R2. And water vapor is liquefied by gas exchange with gases in other fluids, recovered through the heating fluid recovery port 88 and stored in the warm water storage tank 263.

Since high temperature gases discharged from the combustion unit 2 are used directly as the heating fluid, the gas on the other channel R2 is efficiently heated.

Figure 14 shows an apparatus for carbon dioxide recovery and combustion in a fourth mode for carrying out the invention.

As also shown in Figure 15, where the apparatus for carbon dioxide recovery and combustion is different from that in the third mode for implementation, gas discharged from the gas discharge port 43 is used, and therefore a duct 150 leading the gas outward is disposed in the shell 5 of the carbon dioxide recovery unit 1. The duct 150 is arranged in the lower part of

the shell 5. This arrangement facilitates leading of the discharged gas outward.

Also, a cooling means 155 for cooling the gas passing the shell 5 and reaching the duct 150 by spraying is provided. In this way, the trouble of high temperature gas being led outward can be prevented.

The cooling means 155 is connected via an electromagnetic valve 156 to the heating fluid circulation duct 86 which is positioned downstream of the heating fluid suction pump 89 and upstream of the heating fluid storage tank 95, and is provided with a heating fluid injection port 157 disposed in the inner wall of the shell. This heating fluid injection port 157 injects the heating fluid from the electromagnetic valve 156 toward the cylinder 41.

The heating fluid injected from the heating fluid injection port 157 is recovered through the heating fluid recovery port 88 of the heating fluid circulation duct 86. An opening 88b of the heating fluid recovery port 88 is formed inward and upward to make possible recovery of the heating fluid having flowed down inside the cylinder 41 and out of the cylinder 41 through the heating fluid recovery port 88 and the heating fluid injected from the heating fluid injection port 157 and flowing down outside the cylinder 41. This heating fluid injection port 157 is capable of timely injection of heating fluid toward the cylinder 41 by opening or closing the electromagnetic valve 156.

The gas led out of the duct 150 is used for room space heating or cooling, for instance.

Next, a drain pipe 160 for draining water from the heating fluid flowing through the heating fluid circulation duct 88 is disposed on the heating fluid circulation duct 86 farther upstream than the heat exchanger 87a. The drain pipe 160 is connected to the warm water storage tank 263, the cooling fluid storage tank 256 and a heating fluid takeout port 161 and, when there is a surplus of heating fluid flowing through the heating fluid circulation duct 86, water flowing inside is taken out from this drain pipe 160. And water, which is heating fluid, is supplied from the drain pipe 160 to the warm water storage tank 263 or the cooling fluid storage tank 256, or taken outward from the heating fluid takeout port 161 via the drain pipe 160.

Further as shown in Figure 16, this apparatus for carbon dioxide recovery and combustion differs from the foregoing in the structure of a gas-heating fluid heat exchanger 306c.

Thus, a carbon dioxide replenishing pipe 380 to replenish carbon dioxide from the carbon dioxide storage tank 15 into the gas-heating fluid heat exchanger 306c is connected to the gas-heating fluid heat exchanger 306c.

Further, a duct 360 downstream of the gas-heating fluid heat exchanger 306c to be connected to the heating fluid circulation duct 86 is provided with a branched pipe 362 so branched as to enable part of the heating fluid flowing through the duct 360 to return to a duct 361 upstream of the gas-heating fluid heat exchanger 306c. This branched pipe 362 is mounted with, for instance, a space heating device 363 for performing heat exchange between air in a room and heating fluid flowing through the branched pipe 362 and thereby to regulate the humidity in the room. In the drawing, reference numeral 364 denotes the pump of the branched pipe.

Further, an upper end partition wall 370 is disposed near the upper end of the inside of the rotary outer cylinder 323. Between this upper end partition wall 370 and the inner wall at the upper end of the rotary outer cylinder, a primary chamber 371 which is connected to the gas discharge pipe 300 of the combustion unit 2 and into which the gas of the gas discharge pipe 300 flows is formed. The upper ends of the heating pipes 326 penetrate the upper end partition wall 370 to connect the heating pipes 326 to the primary chamber 371.

A lower end partition wall 372 is disposed near the lower end of the inside of the rotary outer cylinder 323. Between this lower end partition wall 372 and the inner wall at the lower end of the rotary outer cylinder, a secondary chamber 373 into which the gas from the heating pipe 326 flows is formed. In the secondary chamber 373, the lower end of the heating pipe 326 penetrates and is connected to the lower end partition wall 372. The secondary chamber 373 also communicates with the space in the tower 314. And the gas flowing through this heating pipe 326 is discharged out of the tower 314 from the gas discharge pipe 300 toward the centrifuge 301 connected to the lower part of the tower 314.

Rubber packings 324 which are in elastic contact with the edge of the heating pipe 326 and absorb the expansion and contraction of the heating pipe 326 are disposed between the upper end of the heating pipe 326 and the inner wall at the upper end of the rotary outer cylinder 323 and between the lower end of the heating pipe 326 and the inner wall at the lower end of and the rotary outer cylinder 323.

In the primary chamber 371, primary chamber fins 375 which receive gas flowing into the primary chamber 371 and provide a turning force to the rotary

outer cylinder 323 are disposed. Also in the secondary chamber 373, secondary chamber fins 376 which receive gas flowing into the secondary chamber 373 and provide a turning force to the rotary outer cylinder 323 are disposed.

Further, the gear mechanism 327 of the gas-heating fluid heat exchanger 306c is accommodated in a gear box 377 in which lubricating oil is stored. To this gear box 377, a duct 310a which is connected to the lubricating oil circulation duct 310 is connected, and lubricating oil within the lubricating oil circulation duct 310 circulates.

Other aspects of configuration are the same as in the foregoing modes for implementation.

This apparatus for carbon dioxide recovery and combustion is operated in the same way as the foregoing apparatuses.

In this operational process, as moisture and the like contained in the outer atmosphere from the air intake 8a during the operation of the carbon dioxide recovery unit 1 are liquefied by heat exchange with nitrogen in the rotor 20 and becomes mixed with water, which is the heating fluid, the quantity of water as the heating fluid increases.

Since this increased water as the heating fluid is supplied to the warm water storage tank 263 or the cooling fluid storage tank 256 via the drain pipe 160 or discharged from the water takeout port 161, the trouble of water as the heating fluid becoming too much on its circulating route can be avoided. Thus, by making the quantity of the heating fluid flowing through the heating fluid circulation duct 86 substantially constant, it is made possible to efficiently heat the heating fluid with the heating fluid heating part 87 or to efficiently heat the gases on the other channel R2 with the heating fluid.

From the duct 150, gases warmed by heat exchange with heating fluid are led out. This enables the gases from the duct 150 to be utilized for room heating or other purposes and thereby to enhance energy efficiency.

Further, the electromagnetic valve 156 causes the heating fluid having been cooled by heat exchange with liquid nitrogen in the cylinder 41 and flowed into the heating fluid circulation duct 86 to reach the heating fluid injection port 157, to be injected from this heating fluid injection port 157, resulting in heat exchange between this injected heating fluid and gases passing the shell 5 and reaching the duct 150 thereby to cool these gases passing the shell 5 and reaching the duct 150. This enables the gases from the duct 150 to be utilized for room cooling or other purposes and thereby to enhance energy efficiency.

When heating fluid is let flow through the branched pipe 362, part of the heating fluid warmed by heat exchange with gas by the gas-heating fluid heat exchanger 306c can be subjected to heat exchange with air in a room by the space heating device 363 and utilized for warming the room space or the like, thereby to enhance energy efficiency.

Even if carbon dioxide, which is the medium, leaks out of the outer cylinder rotor 20, since carbon dioxide in the carbon dioxide storage tank 15 can be replenished from the carbon dioxide replenishing pipe 380 and the quantity of carbon dioxide in the outer cylinder rotor 20 can be thereby kept substantially constant, heat exchange between gases and heating fluid can be efficiently accomplished by the gas-heating fluid heat exchanger 306c.

Other actions and effects are the same those in the foregoing.

Incidentally, it is also acceptable to interlock the power turbine 308 with the generator 70, and the design may be modified as appropriate.

It is also permissible to equip the nitrogen circulation duct 111 with a detour duct which branches out of the nitrogen circulation duct 111 farther downstream of the nitrogen suction pump, which is the compressor 112, and returns to the nitrogen circulation duct 111, and to so arrange this detour duct as to pass the peak of a decently high mountain and to equip the detour duct with a heat exchanger to exchange heat with gases near the peak. In this case, as nitrogen sucked and compressed by the nitrogen suction pump can exchange heat with relatively cold air near the mountain peak, the liquefaction of the nitrogen is accelerated.

Further, it is also acceptable to equip the nitrogen circulation duct 111 with another detour duct which branches out of the nitrogen circulation duct 111 farther downstream of the nitrogen suction pump, which is the compressor 112, and returns to the nitrogen circulation duct 111, and to so arrange this other detour duct as to pass a seawater storage tank into which deep sea water has been pumped up and is stored. In this case, as nitrogen sucked and compressed by the nitrogen suction pump can exchange heat with relatively cold deep sea water, the liquefaction of the nitrogen is accelerated.

CLAIMS

1. An apparatus for carbon dioxide recovery and combustion characterized by being equipped with a carbon dioxide recovery unit which feeds carbon dioxide or a carbon dioxide-containing gas into a container, feeds liquid nitrogen into the container and causes heat exchange between carbon dioxide and liquid nitrogen in the container to cause liquefaction of carbon dioxide, and

a combustion unit into which fluid feed comprising a combustible substance mixed with water is fed, water in the fluid feed is pyrolyzed to burn the combustible substance and a carbon dioxide-containing gas after the combustion is discharged, and at least carbon dioxide in the gas is delivered into the container of the carbon dioxide recovery unit.

2. The apparatus for carbon dioxide recovery and combustion according to Claim 1, characterized in that said carbon dioxide recovery unit is provided with:

a container which permits liquefied carbon dioxide to be taken out from the bottom thereof,

a hollow rotor which, disposed to be rotatable relative to the container, sucks gas and centrifugally separates carbon dioxide toward the outer circumference to compressively collect the gas, injects from a plurality of blast nozzles disposed on the outer circumference said separated and compressively collected carbon dioxide together with liquid nitrogen into said container, and causes heat exchange between carbon dioxide and liquid nitrogen in said container to cause liquefaction of carbon dioxide,

a rotor driving means which turns the rotor,

a gas sucking part which, disposed in said rotor, sucks gas,

a gas discharging part which, disposed in said rotor, discharges unnecessary gases,

a liquid nitrogen sprinkling part which, disposed in said rotor, sprinkles liquid nitrogen in the rotor, and

a liquid nitrogen feeding part which feeds the liquid nitrogen sprinkling part with liquid nitrogen.

3. The apparatus for carbon dioxide recovery and combustion according to Claim 2, characterized in that:

said rotor is formed in a cylindrical shape having said gas sucking part formed at one end in the direction of the rotation axis and said gas discharging part formed at the other end in the direction of the rotation axis,

said rotor driving means having a wall part outside said rotor is provided with a cylinder, disposed to be rotatable relative to said container and rotor, having a gas intake part which is disposed toward the other end in the direction of the rotation axis and into which gas flows from said gas discharging part of the rotor and a gas discharge port which is disposed toward one end in the direction of the rotation axis and from which gas inside is discharged toward outside; a moving vane which, disposed at said gas discharge port, receives the gas being discharged from the gas discharge port and turns said cylinder; a stationary vane which, disposed on a shell covering said container and cylinder, receives the gas being discharged from the gas discharge port; a turning force transmitting mechanism which links the turning force of said cylinder to the turning force of said rotor; a heating fluid scattering part which scatters heating fluid between said rotor and cylinder; and a heating fluid feeding part which feeds the heating fluid scattering part with the heating fluid, wherein:

a turning force is provided to said rotor and cylinder by cooling gas on one channel which passes the inside of the rotor from the gas sucking part of said rotor and reaches the gas discharging part and heating gas on the other channel which passes the outside of the rotor from the gas discharging part of said rotor and reaches the gas discharge port of said cylinder to cause a flow of gas.

4. The apparatus for carbon dioxide recovery and combustion according to Claim 3, characterized in that it is further provided with:

a fulcrum shaft on which said rotor pivots and which is inserted into the rotor, a fixed vane which, disposed on said fulcrum shaft, generates a vortex in gas passing the one channel within said rotor, and a movable vane which, disposed on the inner wall of said rotor, receives the gas made vortical by said fixed vane and turns said rotor.

5. The apparatus for carbon dioxide recovery and combustion according to Claim 3 or 4, characterized in that:

said shell is provided with a duct which, in order to make the gas discharged from said gas discharge port available for use, guides the gas out.

6. The apparatus for carbon dioxide recovery and combustion according to Claim 5, characterized in that it is further provided with:

a cooling means which cools the gas passing said shell to reach said duct by spraying water.

7. The apparatus for carbon dioxide recovery and combustion according to Claim 3, 4, 5 or 6, characterized in that:

said combustion unit is provided with:

a combustion chamber which is supplied, in a state of being intercepted from air supply, with a fluid feed comprising a combustible substance mixed with water, burns the combustible substance by pyrolyzing water in the fluid feed and discharges the gas having been subjected to combustion,

a fluid feed supplying part which supplies said fluid feed to said combustion chamber,

an outer chamber which surrounds the combustion chamber and supports the combustion chamber to permit rotational driving, and

a combustion chamber driving means which rotationally drives said combustion chamber, wherein:

a lower opening which communicates with the inside of the combustion chamber and guides the fluid feed in is disposed in the lower part of said combustion chamber, an upper opening which communicates with said combustion chamber and discharges exhaust is disposed in the upper part of said combustion chamber, said combustion chamber having an outer cylinder and an inner cylinder, and the inner cylinder of said combustion chamber consists of a heat resistant fluid which is pressed onto the outer cylinder by the centrifugal force of said combustion chamber to form the inner wall of the combustion chamber, and

said combustion chamber driving means is provided with a power transmitting mechanism which, in linkage with said cylinder, transmits power deriving from the turning force of the cylinder to the combustion chamber.

8. The apparatus for carbon dioxide recovery and combustion according to Claim 7, characterized in that:

said heating fluid feeding part is provided with:

a heating fluid circulation duct which recovers heating fluid being scattered in said cylinder and circulates the same in said heating fluid scattering part, and

a heating fluid heating part which heats the heating fluid circulating in the heating fluid circulation duct on the route of said heating fluid circulation duct; and

said heating fluid heating part is provided with a heat exchanger which causes heat exchange between gas discharged from said combustion unit and said heating fluid.

9. The apparatus for carbon dioxide recovery and combustion according to Claim 8, characterized in that:

said heat exchanger is provided with:

a tower,

a rotary inner cylinder pivoting on said tower to be rotatable, having a supply inlet for a medium consisting of a gas for heat exchange at one end in the axial direction and a discharge outlet for the medium at the other end, and

a rotary outer cylinder which is disposed to be rotatable relative to said tower and rotary inner cylinder, the wall part thereof being positioned between said tower and the rotary inner cylinder, and seals said medium, wherein:

one channel which reaches the discharge outlet from the supply inlet of said rotary inner cylinder via the inside of the rotary inner cylinder and the other channel which reaches the supply inlet from the discharge outlet of said rotary inner cylinder via the outside of the rotary inner cylinder;

a moving vane which receives the medium flowing into said supply inlet and gives a turning force to the rotary inner cylinder is disposed toward one end of said rotary inner cylinder and a guide vane which guides the medium to said moving vane and gives a turning force to said rotary outer cylinder is disposed on the inner circumference toward one end of said rotary outer cylinder;

a large number of cooling pipes which cause said heating fluid to flow from one end to the other end in the axial direction to cool the medium passing said one channel are arrayed along the axial direction of the rotary inner cylinder, which is the wall part of said rotary inner cylinder,

a large number of heating pipes which cause said gas to flow from one end to the other end in the axial direction to heat the medium passing said other channel are arrayed along the axial direction of the rotary outer cylinder, which is the wall part of said rotary outer cylinder,

a convection of the medium is generated by so providing the medium with a temperature difference as to pass said one channel and the other channel, and motive power is obtained by turning said rotary inner cylinder and rotary outer cylinder with the convection of the medium.

10. The apparatus for carbon dioxide recovery and combustion according to Claim 3, 4, 5, 6, 7, 8 or 9, characterized in that:

part of the gas discharged from said combustion unit is used as said heating fluid.